

CLAIMS

We claim:

Sub A1
1. A method of preheating a substrate which includes a metal-containing layer to a temperature of at least 150 °C, wherein said method comprises exposing said substrate to a preheating plasma which is sufficiently reactive with said metal-containing layer that a deposit or residue formed during preheating which includes metal from said metal-containing layer is more easily etched than said metal-containing layer during a subsequent plasma etching of said metal-containing layer, wherein said metal is selected from the group consisting of platinum, iridium, ruthenium, and combinations thereof..

2. The method of Claim 1, wherein said metal-containing layer is a platinum-containing layer and a first source gas used to produce said preheating plasma includes nitrogen.

3. The method of Claim 2, wherein said platinum-containing layer is platinum.

4. The method of Claim 2 or Claim 3, wherein said first source gas is at least 50 % by volume nitrogen.

5. The method of Claim 4, wherein a second plasma source gas used during subsequent plasma etching of said platinum-containing layer or said platinum layer is at least 15 % by volume nitrogen.

6. The method of Claim 1, wherein said metal-containing layer is a ruthenium-containing layer and a first source gas used to produce said preheating plasma includes a gas selected from the group consisting of nitrogen, oxygen, and combinations thereof.

1 7. The method of Claim 6, wherein said ruthenium-containing layer is ruthenium
2 oxide.

1 8. The method of Claim 6, wherein said ruthenium-containing layer is ruthenium.

1 9. The method of Claim 7 or Claim 8, wherein said first source gas is at least 50 %
2 by volume nitrogen.

1 10. The method of Claim 9, wherein said first source gas is nitrogen.

1 11. The method of Claim 7 or Claim 8, wherein said first plasma source gas is at
2 least 50 % or more oxygen by volume.

1 12. The method of Claim 11, wherein said first plasma source gas is oxygen.

1 13. The method of Claim 9, wherein a second plasma source gas used during
2 subsequent plasma etching of said ruthenium-containing layer is at about 70 % or more
3 oxygen by volume.

1 14. The method of Claim 10, wherein a second plasma source gas used during
2 subsequent plasma etching of said ruthenium-containing layer is about 70 % or more
3 oxygen by volume.

1 15. The method of Claim 11, wherein a second plasma source gas used during
2 subsequent plasma etching of said ruthenium-containing layer is at about 70 % or more
3 oxygen by volume.

1 16. The method of Claim 12, wherein a second plasma source gas used during

2 subsequent plasma etching of said ruthenium-containing layer is about 70 % or more
3 oxygen by volume.

1 17. The method of Claim 1, wherein said metal-containing layer is an iridium-
2 containing layer and a first source gas used to produce said preheating plasma includes a
3 gas selected from the group consisting of nitrogen, oxygen, and combinations thereof.

1 18. The method of Claim 17, wherein said iridium-containing layer is iridium
2 oxide.

1 19. The method of Claim 17, wherein said iridium-containing layer is iridium.

1 20. The method of Claim 18 or Claim 19, wherein said first source gas is at least
2 50 % by volume nitrogen.

1 21. The method of Claim 20, wherein said first source gas is nitrogen.

1 22. The method of Claim 18 or Claim 19, wherein said first plasma source gas is
2 about 50 % or more oxygen by volume.

1 23. The method of Claim 22, wherein said first plasma source gas is oxygen.

1 24. The method of Claim 20, wherein a second plasma source gas used during
2 subsequent plasma etching of said iridium-containing layer is at about 70 % or more
3 oxygen by volume.

1 25. The method of Claim 21, wherein a second plasma source gas used during
2 subsequent plasma etching of said iridium-containing layer is at about 70 % or more

1 30. The method of Claim 29, wherein said first nitrogen-comprising plasma
2 source gas is nitrogen.

1 31. The method of Claim 28 or Claim 29, wherein said second nitrogen-
2 comprising plasma source gas contains about 15 % or more nitrogen by volume.

1 32. The method of Claim 31, wherein said second nitrogen-comprising plasma
2 also includes at least one inert, non-reactive gas selected from the group consisting of
3 helium, neon, argon, krypton xenon, and combinations thereof..

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1 33. A method of plasma heating a substrate and etching a ruthenium-containing
2 layer included in said substrate, said method comprising:
3 a) supplying a first plasma source gas comprising a gas selected from the
4 group consisting of nitrogen, oxygen, or combinations thereof into a process chamber
5 containing said substrate;.
6 b) preheating said substrate to a temperature of at least 150 °C using ion
7 bombardment from a plasma generated from said first plasma source gas;
8 c) supplying a second plasma source gas comprising oxygen to said process
9 chamber; and
10 d) forming a plasma from said second source gas to etch said ruthenium-
11 containing layer while removing ruthenium-comprising deposits generated during said
12 preheating of said substrate.

1 34. The method of Claim 33, wherein said ruthenium-containing layer is
2 ruthenium oxide.

1 35. The method of Claim 33, wherein said ruthenium-containing layer is
2 ruthenium.

1 36. The method of Claim 34 or Claim 35, wherein said first source gas is at least

2 50 % by volume nitrogen.

1 37. The method of Claim 36, wherein said first source gas is nitrogen.

1 38. The method of Claim 34 or Claim 35, wherein said first source gas is about 50
2 % or more oxygen by volume.

1 39. The method of Claim 38, wherein said first plasma source gas is oxygen.

1 40. The method of Claim 36, wherein said second plasma source gas used during
2 subsequent plasma etching of said ruthenium-containing layer is at about 70 % by
3 volume or more oxygen.

1 41. The method of Claim 37, wherein said second plasma source gas used during
2 subsequent plasma etching of said ruthenium-containing layer is about 70 % by volume
3 or more oxygen.

1 42. The method of Claim 38, wherein said second plasma source gas used during
2 subsequent plasma etching of said ruthenium-containing layer is at about 70 % by
3 volume or more oxygen.

1 43. The method of Claim 39 wherein said second plasma source gas used during
2 subsequent plasma etching of said ruthenium-containing layer is about 70 % by volume
3 or more oxygen.

2 44. A method of plasma heating a substrate and etching an iridium-containing
3 layer included in said substrate, said method comprising:

a) supplying a first plasma source gas comprising a gas selected from the

4 group consisting of nitrogen, oxygen, and combinations thereof into a process chamber
5 containing said substrate;.

6 b) preheating said substrate to a temperature of at least 150 °C using ion
7 bombardment from a plasma generated from said first plasma source gas;

8 c) supplying a second plasma source gas to said process chamber; and

9 d) forming a plasma from said second source gas to etch said iridium-
10 containing layer while removing iridium-comprising deposits generated during said
11 preheating of said substrate..

1 45. The method of Claim 44, wherein said second source gas includes oxygen.

1 46. The method of Claim 44 or Claim 45, wherein said iridium-containing layer is
2 iridium oxide.

1 47. The method of Claim 44 or Claim 45, wherein said iridium-containing layer is
2 iridium.

1 48. The method of Claim 44, wherein said first source gas is at least 50 % by
2 volume nitrogen.

1 49. The method of Claim 44, wherein said first source gas is about 50 % or more
2 oxygen by volume.

1 50. The method of Claim 45, wherein said second plasma source gas used during
2 subsequent plasma etching of said iridium-containing layer is at about 70 % by volume
3 or more oxygen.

1 51. The method of Claim 46, wherein said second plasma source gas used during

2 subsequent plasma etching of said iridium-containing layer is about 70 % by volume or
3 more oxygen.

1 52. The method of Claim 47, wherein said second plasma source gas used during
2 subsequent plasma etching of said iridium-containing layer is at about 70 % by volume
3 or more oxygen.

1 53. The method of Claim 48, wherein said second plasma source gas used during
2 subsequent plasma etching of said iridium-containing layer is at about 70 % by volume
3 or more oxygen.

1 54. The method of Claim 49, wherein said second plasma source gas used during
2 subsequent plasma etching of said iridium-containing layer is at about 70 % by volume
3 or more oxygen.

1 55. The method of Claim 50, wherein said second plasma source gas includes an inert,
2 non-reactive gas selected from the group consisting of helium, neon, argon.

1 56. The method of Claim 51, wherein said second plasma source gas includes an inert,
2 non-reactive gas selected from the group consisting of helium, neon, argon.

1 57. The method of Claim 52, wherein said second plasma source gas includes an inert,
2 non-reactive gas selected from the group consisting of helium, neon, argon.